EFFECT OF BASIC RESISTANCE TRAINING VERSUS PLYOMETRIC TRAINING IN HIGH SCHOOL FOOTBALL PLAYERS

(Reg No: 271550101)

A Dissertation Submitted to

THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY

Towards partial fulfilment as a requirement for the degree

MASTER OF PHYSIOTHERAPY

MAY - 2017

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CERTIFICATE

This is to certify that the research work entitled **"EFFECT OF BASIC RESISTANCE TRAINING VERSUS PLYOMETRIC TRAINING IN HIGH SCHOOL FOOTBALL PLAYERS"** was carried out by the candidate with the (**REG NO: 271550101**) Master of physiotherapy student at Thanthai Roever Collage of Physiotherapy, Perambalur, submitted to Tamil Nadu Dr. M.G.R. Medical University, Chennai towards the partial fulfilment as a requirement for the Degree Master of Physiotherapy (MPT-SPORTS).

PLACE: **Prof. C.V. JOHN FRANKLIN, MPT., MIAP.,**

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Perambalur -621212

CERTIFICATE

This is to certify that the research work **"EFFECT OF BASIC RESISTANCE TRAINING VERSUS PLYOMETRIC TRAINING IN HIGH SCHOOL FOOTBALL PLAYERS"** was carried out by the candidate with the **(REG NO: 271550101)** Thanthai Roever College of Physiotherapy Perambalur under the guidance of me towards the partial fulfilment as a requirement for the degree Master of Physiotherapy Submitted to The Tamil Nadu Dr. MGR Medical University Chennai. (MPT - SPORTS).

GUIDE: Mr. IBRAHIM SHERIFF, MPT, MIAP (SPORTS)

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INTRODUCTION

Football is a team sport in which players attempt to score goals by passing and dribbling the ball down the field past opposing defenders and kicking or heading the ball into the goal net, outwitting the defending goalkeepers.

This is a sport which involves more of kicking, sprinting and jumping.[19] The nature of the game often claims the athletes' undertaking intensive repeated sprinting efforts over a relatively prolonged period.[20] It requires greater explosive leg strength and also jumping performance. Football requires many explosive athletes with the players required to kick the ball, jump and also sprint.[19]

Strength training plays a very important role in improving the power of the jump and the athletics performance. The strength of the leg muscles in general and vertical jump performance and kicking performance in particular are considered as critical elements for successful athletic performance.[3] The functional stability of the knee joint is entirely dependent on the intact ligament and the effective contraction of the supporting musculature.[18]

Quadriceps and hamstrings muscle are supportive musculature and their strength seems to demonstrate a significant contribution in improving the athletes performance.[1]The strength increases more during the low velocity movement of the phase of eccentric contraction than during the increased velocity of this phase, therefore a weight training program may stimulate increase in strength adaptations.[16] Quadriceps strength must be maintained, because deficits in the strength predisposes the person to limited athletics performance.

Therefore in accordance to the variations in quadriceps and hamstrings in functional performance, this study is designed to assess the effectiveness of quadriceps and hamstring strengthening in functional performance in athletes.

For all football players dynamic balance is an important aspect. Dynamic balance along with power is the greatest physical predictors of success in sports that require speed**.** Improvement in dynamic balance leads to better football player and overall athlete.[31]

Static balance, which can be maintained with minimal movement, should be distinguished from dynamic balance. Ability to maintain center of gravity over a constantly changing base of support is critical to success on the football field and is the essence of dynamic balance. The ability to "stay on your feet (under control)" and "make the play" distinguishes great football players from other football players**.** Postural strength and control is also necessary to achieve dynamic balance.[31]

Muscular balance establishes the correct ratio between muscular strength, endurance and power between agonist and antagonist. “Muscle balance” refers to the relationship between the agonist (group of contracting muscles) to the antagonist (passive opposition muscles). Each time you work out a muscle, you want to give the opposing muscle an equal work out. [32]

One of the goals in a resistance program is balance. Proper resistance training enhances an effective quadriceps and hamstring strengthening and thus helps to maintain the balance between quadriceps and hamstring muscle strength. This allows the player to maintain a good static and dynamic balance which is required for jumping, kicking performance and an overall athletic performance. As the knee extends, the quadriceps contract (agonist) and the hamstrings are passively stretched (antagonist).[32]

As the athlete enhances his maximum strength he also benefit from improvement in other performance characteristics of neuromuscular function like power and kicking performance.[21]

RESISTANCE TRAINING:

Resistance exercise is any form of active exercise in which a dynamic or a static muscle contraction is resisted by an outside force applied either manually or mechanically. This is also referred as Resistance Training. (Kisner and Colby 4 Edition page no-59) .

Maximal benefits of resistance training may be gained via adherent to three basic principles:

a) Overload
b) Specificity
c) Reversibility

Progression and resistance training program design

Coaches and athletes are well aware that the system of resistance training they select will influence strength, power, endurance and host of other parameters to difficult degrees. Different training method will induce different adaptation. Even among strength trained athletes, the manipulation of few training variables will produce vast different results, demonstrating the importance of carefully designing the resistance training program to achieve the desired training targets.

The resistance training program is composite of acute variables. These variables include:

- Muscle action used
- Resistance used
- Volume
- Rest intervals
- Speed of exercise
- Frequency
- Mode of exercise
- Duration

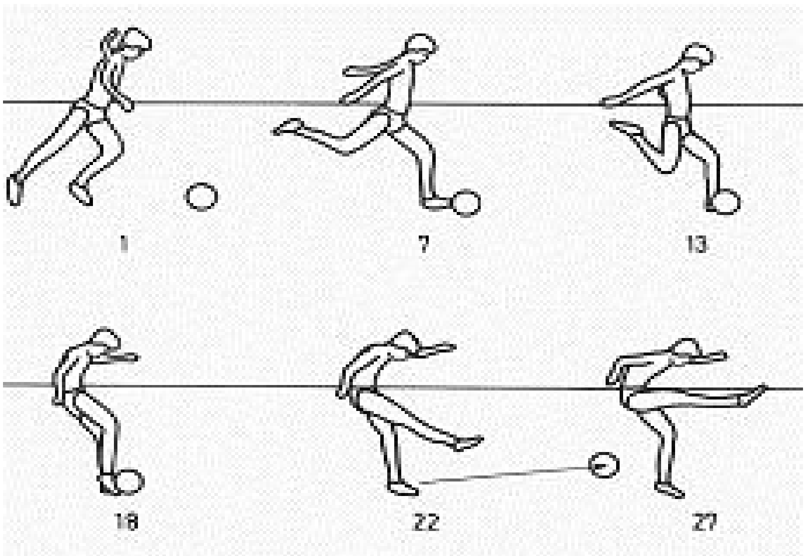
Altering one or several of these variables will affect the training stimuli, thus creating favorable condition by which numerous way exist to vary resistance training program and maintain / increase participant motivation. Therefore, proper resistance exercise prescription involves manipulation of variable to the specificity of targeted goals.[23]

Kicking is a series of rotational movements. It is a complex motor task, which rapidly develops between the ages of four and six.[29]

Biomechanical Analysis of Kicking

1) Foot is kept back in order to gain enough kinetic energy before you hit the ball so the ball will move due to the kinetic energy of the foot.
2) Work is done by the foot on the ball- you have to work against gravity (muscles have to exert a torque against the gravity torque).
3) Release Phase: torque due to gravity will change gravitational potential energy of the leg to kinetic energy thus transferring energy from the foot to the ball.[29]

Kicking phases in a maximal kick (Luhtanen 1984)[29]



Athletic Application of Kicking

The kick action can be broken down into 6 stages:

- The approach
- Plant-foot forces
- Swing-limb loading
- Hip flexion and knee extension
- Foot contact
- Follow-through

The Approach: As a child develops their kicking pattern they learn to pace the run up and adjust their approach into a diagonal angle. A 45-degree angle produces the greatest peak ball velocity.

Plant-foot Forces: The ground reaction force on the plant foot directly affects the ball speed. There is also a direct relationship between the direction of the plant foot and the direction the ball travels. The most accurate direction of the ball can be accomplished when the foot plant position is perpendicular to a line through the center of the ball. The optimal anterior-posterior (A-P) position of the plant foot is adjacent to the ball. This A-P position determines the flight path of the kicked ball.

Swing-limb loading: The swinging of the limb prepares for the descending motion towards the ball. During this phase the opposite arm is raised to counter balance the rotating body. Both arms help keep the center of gravity over the support foot and increase the moment of inertia of the trunk. The kicking leg is extended and the knee is flexed to store elastic energy and allow a greater transfer of force to the ball. At the end of this phase there is maximal eccentric activity in the knee extensors.

Hip flexion and knee extension: In this phase the thigh is swung forward and downward with a forward rotation of the lower leg. The leg then begins to accelerate due to the combined effect of the transfer of momentum and release of stored elastic energy in the knee extensors. The knee extensors then powerfully contract to swing the leg and foot towards the ball. After the kicking leg makes contact with the ball the knee is extended and the foot is plantar flexed. At this time the hamstrings are maximally activated to slow the leg's eccentric movement.

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AGONISTS and ANTAGONISTS muscles involved in kicking action-

Agonists:

1. Hip flexors: rectus femoris, iliopsoas, Sartorius
2. Knee extensors: Quadriceps
3. Dorsi flexors

Antagonists:

1. Hamstrings
2. Gastrocnemius
3. Plantarflexors[29]

Kicking plays a very important role in enhancing the athletic performance. The balance between quadriceps and hamstring muscles should be maintained to reduce the muscle strains and knee injuries and enhance the functional performance of an athlete. So in my study kicking is used as a parameter to evaluate the functional performance of an athlete.[29]

PLYOMETRIC TRAINING

It is highly effective form of power training along with strength training. Plyometric training often called as plyometrics is defined as system of high velocity resistance training characterized by rapid eccentric contractions during which the muscle elongates followed immediately by a reversal of movement with resisted shortening concentric contraction of the same muscle.(Kisner and Colby 4 Edition page no.-126).[17]

How Plyometric Exercises Work

A muscle that is stretched before a concentric contraction, will contract more forcefully and more rapidly. A classic example is a dip" just prior to a vertical jump. By lowering the center of gravity quickly, the muscles involved in the jump are momentarily stretched producing a more powerful movement. Two models have been proposed to explain this phenomenon.[30]

The Stretch-Shortening Cycle

All plyometric movements involve **three** phases. The first phase is the pre-stretch or eccentric muscle action. Here, elastic energy is generated and stored. The second phase is the time between the end of the pre-stretch and the start of the concentric muscle action. This brief transition period from stretching to contracting is known as the **amortization** phase. The shorter this phase is, the more powerful the subsequent muscle contraction will be. The third and final phase is the actual muscle contraction. In practice, this is the movement the athletes desires the powerful jump or throw. This sequence of three phases is called the **stretch-shortening cycle**. In fact, plyometrics could also be called stretch-shortening cycle exercises.[17]

How to Increase Your Vertical Jump

Simple way to demonstrate the effect of the stretch-shortening cycle is to perform two vertical jumps. During the first vertical jump the athlete bends the knees and hips (eccentric muscle action or pre-stretch) and holds the semi-squat position for 3-5 seconds before jumping up vertically (concentric contraction) as high as possible. The 3-5 second delay increases the amortization phase. On the second jump the athlete bends the knees and hips to the same degree but immediately jumps up without a delay. This keeps the amortization phase to a minimum and makes best use of the stored elastic energy. The second jump will be higher.[30]

Is Plyometric Training Really That Effective?

By making use of the stretch-shortening cycle, movements can be made more powerful and explosive. Plyometrics is simply a set of drills designed to stimulate the series elastic component over and over again preferably during movements that mimic those is the athletes sport. [30]

NEEED OF STUDY

Football basically involves kicking action of the leg. Inadequate hamstrings strength or imbalance between quadriceps and hamstrings are the major causative factors for muscle strains and knee injuries in football players.[14]

So strengthening of quadriceps and hamstrings muscle plays a very important role in the performance of the football players so as to prevent this injuries.[14]

The Basic Resistance Training program helps in improving the strength of these muscles thus reducing the injury rates and also enhances the kicking performance Additionally a plyometric program is utilized to improve the muscular performance, jumping performance and kicking performance. Thus it increases the dynamic stability and prevents the injuries around the knee.[4]

HYPOTHESIS

NULL HYPOTHESIS –

Plyometric Training and Basic Resistance Training both are equally effective to improve the strength, power and kicking distance in high school football players.

ALTERNATE HYPOTHESIS –

1. Plyometric Training is effective over Basic Resistance Training to improve the strength, power and kicking distance in high school football players.

2. Basic Resistance Training is effective over Plyometric Training to improve the strength, power and kicking distance in high school football players.

AIM AND OBJECTIVES

Aim:

To study the effect of Basic Resistance Training versus Plyometric Training on strength, power and kicking distance in football players.

Objectives:

1) To study the effect of Basic Resistance Training on quadriceps and hamstrings strength in football players.
2) To study the effect of plyometric training on quadriceps and hamstrings strength in football players.
3) To study the effect of Basic Resistance Training and Plyometric Training on power.
4) To study the effect of Basic Resistance Training and Plyometric Training on Kicking Distance.
5) Compare the two methods of training to improve the strength, power and kicking distance.

REVIEW OF LITERATURE

1. **Lex B. Verdijk et al (2009)** concluded that 1RM testing represents a valid means to assess leg muscle strength. Considering the importance of training specificity in strength assessment, he concluded that 1-RM testing can be applied to assess the changes in the leg muscle strength following an exercise intervention.

2. **Thomas, Kelvin et al (2009)** included in their study males from a semiprofessional football clubs academy age group = 17.3 ± 0.4 years.

3. **Itamar Levingera et al (2009)** conducted a study to examine the reliability of the 1RM strength tests on untrained middle-aged individuals and concluded that 1RM is a reliable method of evaluating the maximal strength in untrained middle-aged individuals. It appears that 1RM-testing protocols that include one familiarization session and one testing session are sufficient for assessing maximal strength in this population.($r > 0.9$).

4. **Tim R. Henwood et al (2008)** in their study found that 1RM can be calculated using 3-5 attempts to avoid fatigue. Hence, 3-5 attempts were used for calculating 1 RM in this study.

5. **Kisner (2007)** stated that 1 RM should not be categorically eliminated as a viable method of determining a baseline measurement of strength in all population other than young athletes. Therefore 1 RM was taken as an outcome measure for the study.

6. **Goran Markovic et al (2007)** studied that Plyometric Training provides a statistically significant and practically relevant improvement in the vertical jump height thus justifying the application of Plyometric Training for the purpose of development of vertical jump performance in healthy individuals.

7. **Michael G. Miller et al (2006)** said that plyometric training, when used with a periodized strength-training program, can contribute to improvements in vertical jump performance, acceleration, leg strength, muscular power, increased joint awareness, and overall proprioception.

8. **SM Lephart et al (2005)** concluded that basic resistance program helps in improving the strength of the muscles thus reducing the injury rates. Additionally a plyometric program is further utilized to improve the muscular performance. Thus it increases the dynamic stability and prevents the injuries around the joint.

9. **GM Verall (2005)** said the nature of the game often claims that the athletes undertake intensive repeated sprinting efforts over a relatively prolonged period.

10. **Rahman Rahimi et al (2005)** proved that vertical jump height was measured by the stand and reach test (Chu, 1996). A vertical jump test was completed from a 2-foot standing position without a step into the jump. The subjects were allowed to use their hands as they desired. Three test jumps were completed, and the highest of these was recorded. This test was selected because it has high validity

(0.80) and reliability (0.93) This study clearly illustrates the close working relationship between neuromuscular efficiency (e.g., multiple fiber recruitment and facilitating the stretching reflex) and dynamic strength performance. He concluded that plyometrics permits effective use of this strength to produce explosiveness in sports or events demanding speed and quickness.

11.MOIR, GAVIN et al (2004) proved that high levels of reliability can be achieved without the need for familiarization sessions when using SJ to assess the athletic performance of physically active men.

12.**C Woods (2004)** said that the hamstring strain is a condition well recognized by medical personnel, coaches, and athletes. Such injuries are a major cause of time lost from sport. Hamstring strains are among the most common injuries in sport and are most often observed in sports that involve sprinting and jumping.

13.**Radmila Kostić et al (2003)** proved in his study that the exercise program with 75% of 1RM intensity had a better effect on the development of the muscle strength.

14.**E.C. Rhodes et al (2003)** in his study used leg press for performing exercises in which subjects were asked to complete the concentric phase in 2-3 seconds and slowly lower the weight i.e. eccentric phase in 3- 4 seconds.

15. **Benedict Tan et al (1999)** proved that the weight training or resistance training is one of the most popular forms of exercise for enhancing an individual's fitness as well as for conditioning athletes. Coaches and athletes are well aware that the system of resistance training they select will influence strength and power.

16. **Pincivero DM ; Lephart SM et al (1997)** studied that the hamstrings muscle strength plays a very important role during the propulsive phase thereby enabling the subject to jump further.

17. **Rober U et al (1994)** proved that both heavy and light resistance training can be used in training of muscular power. Maximum strength can be developed through carefully designed resistance training program.

18. **Bill Foran** stated the definition of vertical jump as the jump reach minus the standing reach. The "standing reach" is how high you can extend one arm above your head while keeping both feet together and flat on the floor. The jump reach, for a true vertical jump test, is to jump straight up without taking a step and touch the highest point possible.

MATERIALS AND METHODOLOGY

Study type

Experimental

Study design

Comparative study

Study setting

Bharti Vidyalaya high school

Sample technique

Convenient sampling with random allocations

Sample size

Total number of subjects in the study, n= 30, aged between 14-18 years. Out of 30, 27 were able to complete the study.

Target Population

Amateur Football Players

Demography

Subjects were randomly allocated in two groups. Following figure shows the demographic distribution of included subjects.

Randomized 30

Group 1	Group 2
Basic Resistance Training	Plyometric Training
n = 15	n = 15
Lost to follow up	Lost to follow up
n =2	n=1
Completed study	Completed study
n=13	n=14

Sampling criteria

INCLUSION CRITERIA:-

- High School Football Players (male players)
- Football players between the age group of 14-18 years

EXCLUSION CRITERIA:-

- Subjects reporting history of lower extremity injury.
- Subjects reporting history of any injury to upper limb.
- History of any other musculoskeletal disorders.

MATERIALS REQUIRED

- Quadriceps table machine
- Hamstring Curl machine
- Stepper
- Plyometric Box
- Cones
- Football
- Measuring tape
- Chalk piece
- Weight cuffs

PROCEDURE: -

High school football players who fulfill the inclusion criteria were taken for the study purpose. Only those players who can understand instruction were taken for the study purpose and written consent regarding their voluntary participation in the study was taken. 30 football players were randomly selected from Bharti Vidyalaya high school. Their strength was assessed with the help of 1 RM. Power was assessed by static vertical jump test and functional performance with the help of kicking distance before and after training.

1RM was calculated for Quadriceps and Hamstrings by asking the subject to lift the maximum amount of weight through the available range of motion just one time. To avoid muscle fatigue, weights were set, 1 RM lift was achieved within 3-5 attempts and a rest of 30 sec was given between each attempt.[1/16]

For quadriceps the 1RM was assessed in sitting position on chair with legs hanging along the edge of the chair with the trunk supported to back of chair and for Hamstring it was assessed in prone position on the couch with the pelvis stabilized with the belt.[17]

Strength training for quadriceps and hamstrings was given at 75% of 1RM.[17/15] The training was given for 4 weeks with 4 days per week. The strength was assessed after 2 weeks and again after 4 weeks.[4]

The **static vertical jump test** consisted of a person to jump as high as possible. The subjects were asked to stand 6 inches (15.2 cm) side on to a wall reached up with the hand closest to the wall. Keeping the feet 4 inches apart flat on the ground, the point of the fingertip was marked and recorded. This was the standing reach. The subjects were then asked to bend down swing his both arms down and back, quickly swing both arms forward and up and jump vertically as high as possible using both arms and legs to assist in projecting the body upwards and to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and jump height was the score. 3 trials were performed recording the highest jump. A brief recovery period of 30 sec was given between each trial.[7] The power was assessed in terms of static vertical jump test.

Kicking Distance was measured in meters to evaluate the athletes' functional performance. Cones and markers were kept at distance of 5 meters along a straight line covering up a distance of 50 meters using a meter tape. The player was made to kick the ball at the starting point. The player took a two-step run up and then kicked the ball at the starting point. The point at which the ball strikes the ground first was marked and the distance was measured with the help of the measuring tape.

The players were divided into two groups with 15 players in each group. **Group 1** was given Basic Resistance Training and **Group 2** was given plyometric Training.

Basic Resistance Training – For 4 WEEKS (4 DAYS/WEEK) [4]GROUP-1

Flexibility (3 rep) 30 sec - Quadriceps, Hamstrings, Calf.

Balance (3 rep) 15 sec- Single Leg Balance. Single Leg Balance with Flexed Knee, Single Leg Balance with Perturbations.

Resistance (20 rep) – Lateral Step Down, Calf Raises , Hamstring Curls with Weights, Leg Extension with weights, Forward/Lateral Lunges, One Leg Squat.

Plyometric Training – For 4 WEEKS (4 DAYS/WEEK) [4]GROUP-2

Flexibility (3 rep) 30 sec - Quadriceps, Hamstrings, Calf.

Plyometrics (20 rep) – Single/double leg forward hops, Single/double leg broad jump, Single/double leg jump from the box, Double leg backward hop, Double leg lateral hop, Double leg jump-lunge-jump.

Agility (5 rep) – Shuttle run, 45 degree cut, 90 degree cut, high Knee.

STATISTICAL ANALYSIS

The statistical tests used for the analysis of the result were:

1) Paired t-test
2) Unpaired t- test

Mean, standard deviation and standard error was carried out for all the groups in this study for both the groups. In this table following statistical formulae have been used for analysis:

1. **Mean** = $\frac{\Sigma X_i}{n}$

Where,

ΣX_i = Sum of total readings

n = Number of samples

2. **Standard Deviation** (SD)= $\frac{\Sigma (X_i - \bar{X})^2}{n - 1}$

Where,

X_i = Individual values

$\bar{X}$ = Mean

n = Number of samples

3. **Standard Error (SE) of mean** $= \frac{SD}{\sqrt{n}}$

Where,

SD = Standard Deviation

$\sqrt{n}$ = Square root of number of samples

Paired t test was used to compare the pre and post training measurements.

$$t = \frac{\sum d}{\sqrt{Nd^2 - (\sum d)^2 / N - 1}}$$

Where, $\sum d$ =the total of the difference

$\sum d^2$ =the total of the difference squared

$(\sum d)^2$=the total of the squared differences

. N = Total number of samples.

Formula for calculation of data by unpaired t-test is

$$t = \frac{\bar{X}_1 \quad \bar{X}_2}{\sqrt{\frac{SD_1^2}{n_1} + \frac{SD_2^2}{n_2}}}$$

- X_1 is the mean value of first sample
- X_2 is the mean value of second sample
- SD1 – Standard deviation of first sample
- SD2 – Standard deviation of second sample
- n1 – Sample size of the first sample
- n2 – Sample size of the second sample

Table 1: Comparison between 0-2- 4 Weeks 1RM Quadriceps In Group 1

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	9.346	13	3.158	0.8759
2 WEEKS	12.15	13	3.514	0.9747
4 WEEKS	17.38	13	5.261	1.459

B: Students paired t test

	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-2.808	1.331	-7.604	0.000 S,p<0.05
2-4 WEEKS	-5.231	2.242	-8.413	0.000 S,p<0.05
0-4 WEEKS	-8.038	2.817	-10.288	0.000 S,p<0.05

Table 2: Comparison between 0- 2- 4 Weeks 1RM HAMSTRINGS In Group 1

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	5.692	13	1.82	0.5049
2 WEEKS	7.308	13	2.471	0.6853
4 WEEKS	10.69	13	3.237	0.8979

B: Students paired t test

	Mean	Std. Deviation	t-value	P-value
0-2 WEEKS	-1.615	0.8204	-7.099	0.000 S,p<0.05
2-4 WEEKS	-3.385	1.21	-10.083	0.000 S,p<0.05
0-4 WEEKS	-5	1.646	-10.954	0.000 S,p<0.05

Graph 1: Comparison between 0-2- 4 Weeks 1RM Quadriceps and Hamstrings in Group 1

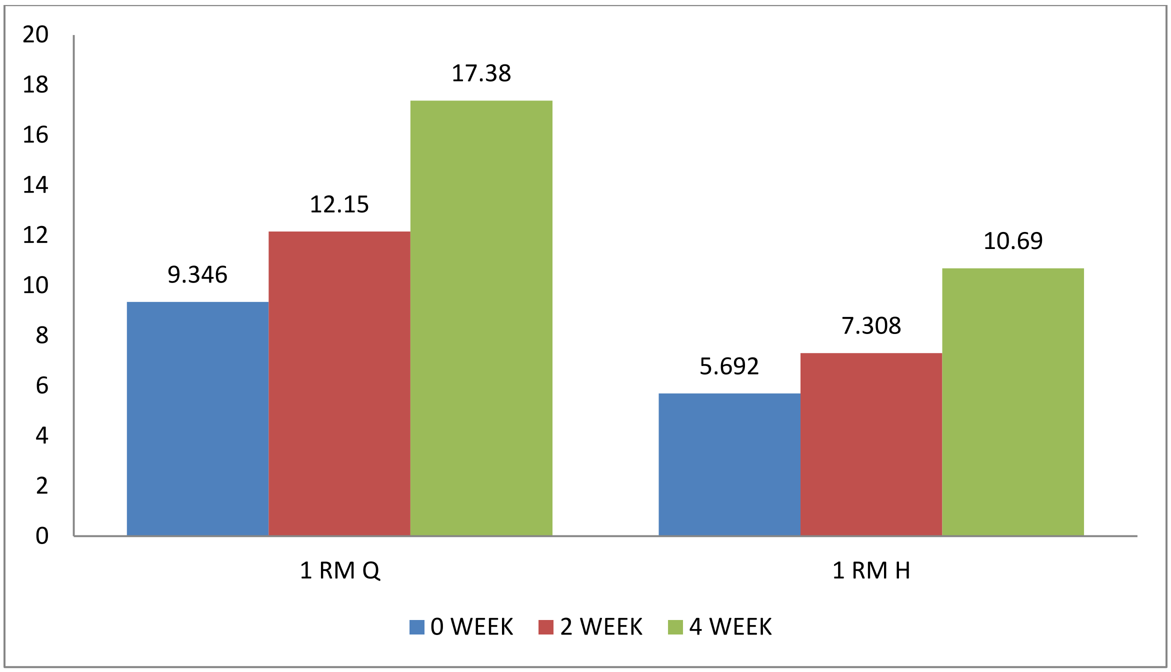


Table 3: Comparison between 0-2- 4 Weeks 1RM Quadriceps In Group 2

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	6.75	14	2.073	0.5541
2 WEEKS	8.286	14	2.392	0.6392
4 WEEKS	10.36	14	2.678	0.7157

B: Students paired t test

	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-1.536	0.6033	-9.524	0.000 S,p<0.05
2-4 WEEKS	-2.071	1.107	-7.002	0.000 S,p<0.05
0-4 WEEKS	-3.607	1.163	-11.603	0.000 S,p<0.05

Table 4: Comparison between 0-2- 4 Weeks 1RM HAMSTRINGS- In Group 2

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	4.429	14	0.5136	0.1373
2 WEEKS	5.214	14	1.59	0.4249
4 WEEKS	6.5	14	1.316	0.3176

B: Students paired t test

	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-0.7857	1.297	-2.267	0.041 S,p<0.05
2-4 WEEKS	-1.286	1.188	-4.048	0.001 S,p<0.05
0-4 WEEKS	-2.071	0.8516	-9.101	0.000 S,p<0.05

Graph 2: Comparison between 0-2- 4 Weeks 1RM Quadriceps and Hamstrings in Group 2

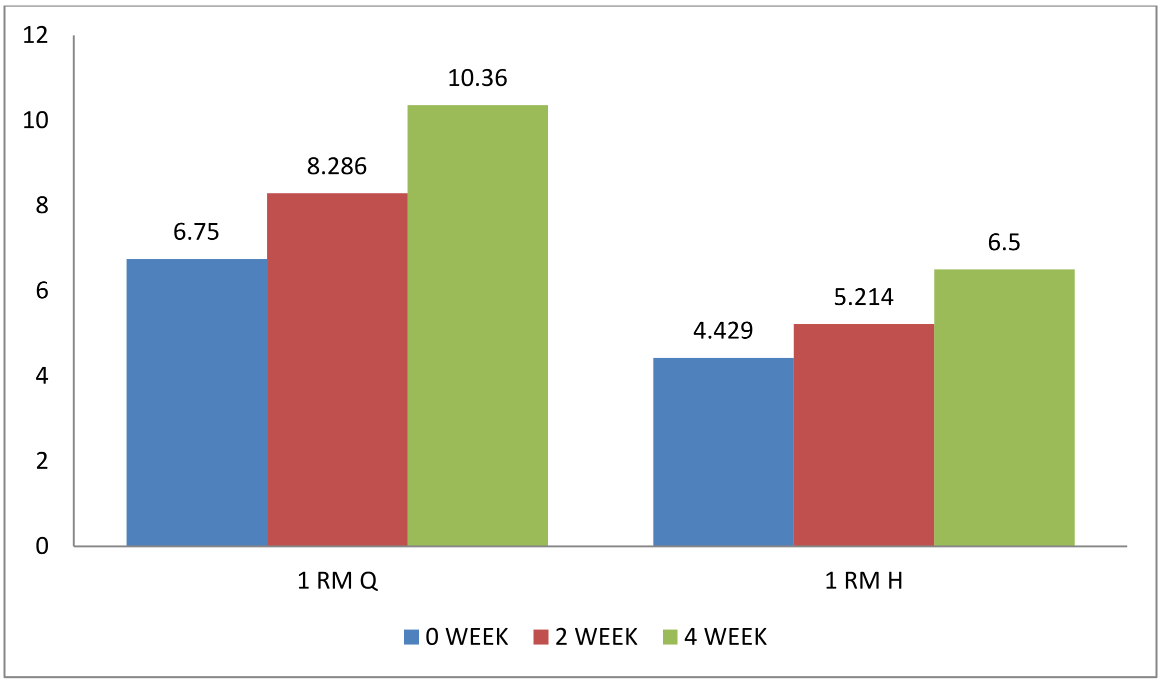


Table 5: Comparison between 0-2- 4 Weeks SVJ in Group 1

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	230.2	13	12.21	3.387
2 WEEKS	236.5	13	11.74	3.257
4 WEEKS	242.6	13	13.95	3.869

B: Students paired t test

	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-6.308	4.768	-4.770	0.000 S,p<0.05
2-4 WEEKS	-6.154	4.488	-4.944	0.000 S,p<0.05
0-4 WEEKS	-12.46	8.569	-5.243	0.000 S,p<0.05

Graph 3: Comparison between 0-2- 4 Weeks SVJ in Group 1

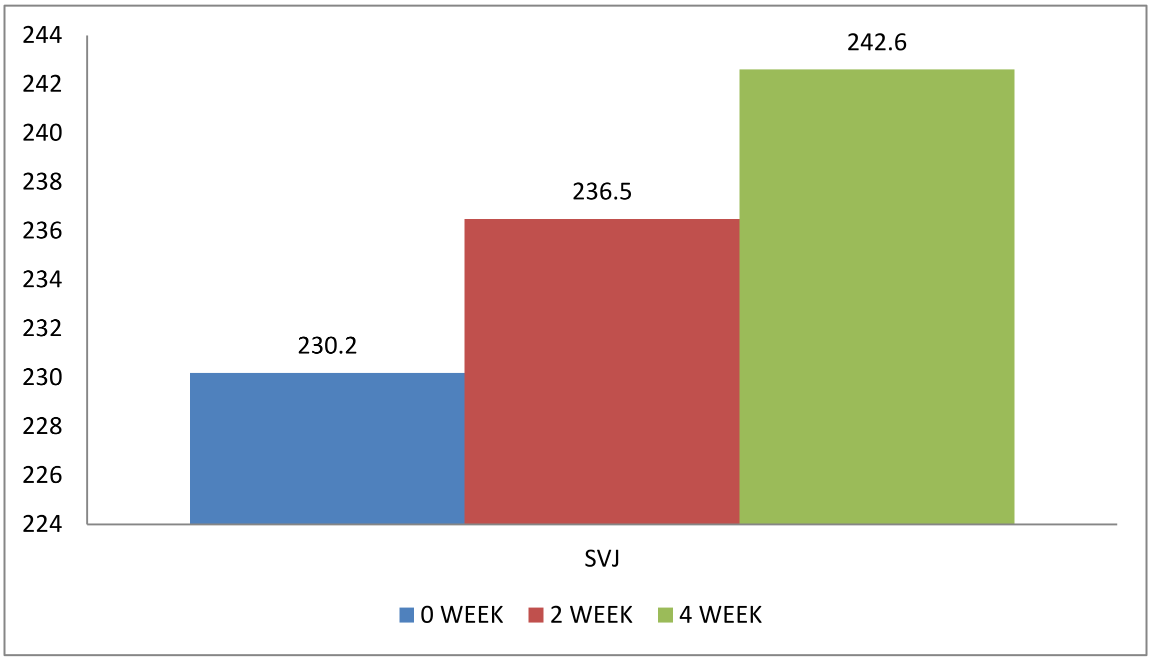


Table 6: Comparison between 0-2- 4 Weeks SVJ in Group 2

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	179.4	14	74.78	19.99
2 WEEKS	223.1	14	19.07	5.096
4 WEEKS	229.9	14	18.51	4.948

B: Students paired t test

	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-43.64	72.93	-2.239	0.043 S,p<0.05
2-4 WEEKS	-6.786	2.155	-11.783	0.000 S,p<0.05
0-4 WEEKS	-50.43	73.4	-2.570	0.023 S,p<0.05

Graph4: Comparison between 0-2- 4 Weeks SVJ in Group 2

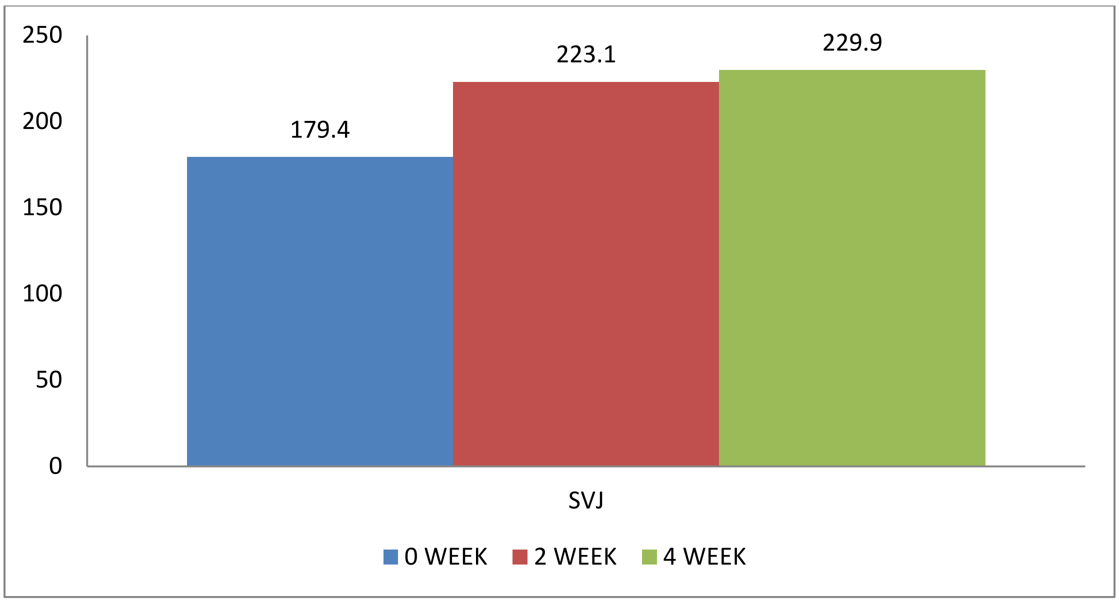


Table7: Comparison between 0-2- 4 Weeks KD in Group 1

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	21.77	13	5.294	1.468
2 WEEKS	25.81	13	6.372	1.767
4 WEEKS	28.77	13	7.56	2.097

B: Students paired t test

	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-4.038	2.25	-6.473	0.000 S,p<0.05
2-4 WEEKS	-2.962	1.761	-6.062	0.000 S,p<0.05
0-4 WEEKS	-7	3.434	-7.350	0.000 S,p<0.05

Graph5: Comparison between 0-2- 4 Weeks KD in Group 1

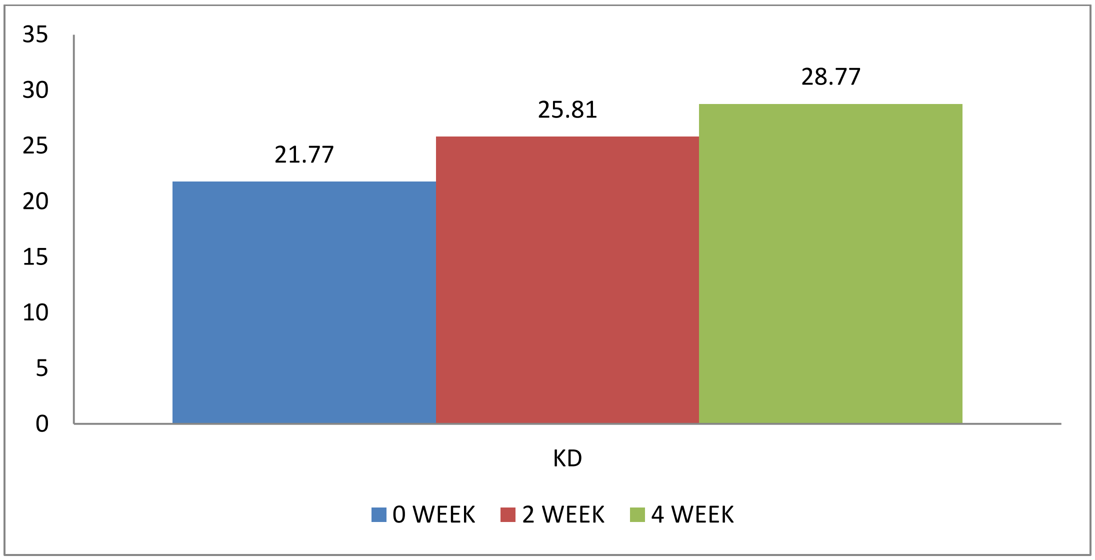


Table8: Comparison between 0-2- 4 Weeks KD in Group 2

A: Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
0 WEEKS	17.07	14	5.612	1.5
2 WEEKS	20.79	14	6.877	1.838
4 WEEKS	26.46	14	7.191	1.922

B: Students paired t test

	MEAN	Std. Deviation	t-value	p-value
0-2 WEEKS	-3.714	1.684	-8.254	0.000 S,p<0.05
2-4 WEEKS	-5.679	1.694	-12.543	0.000 S,p<0.05
0-4 WEEKS	-9.393	2.459	-14.294	0.000 S,p<0.05

Graph6: Comparison between 0-2- 4 Weeks KD in Group 2

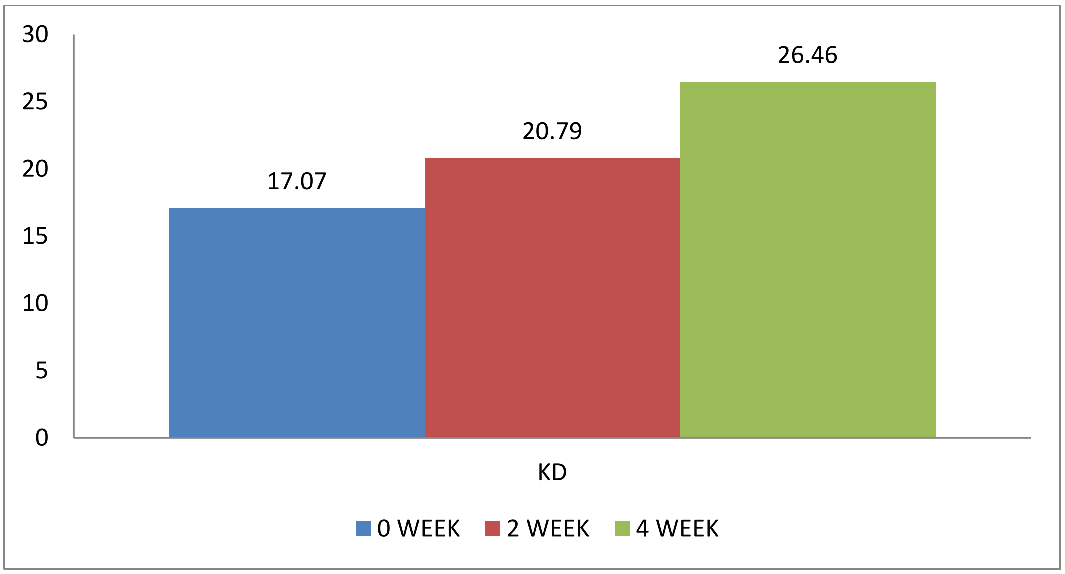


Table 9: Comparison between 0-2- 4 Weeks 1RM Quadriceps between group 1 and 2

A: Descriptive Statistics

GROUP 1	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-2.808	13	1.331	0.3692
2-4 WEEKS	-5.231	13	2.242	0.6218
0-4 WEEKS	-8.038	13	2.817	0.7813

GROUP 2	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-1.536	14	0.6033	0.1612
2-4 WEEKS	-2.071	14	1.107	0.2959
0-4 WEEKS	-3.607	14	1.163	0.3108

B: Students t test

	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-1.272	1.331	-3.239	0.003 S,p<0.05
2-4 WEEKS	-3.16	2.242	-4.698	0.000 S,p<0.05
0-4 WEEKS	-4.431	2.817	-5.416	0.000 S,p<0.05

Graph7: Comparison between Group 1 and 2 - 1RM Quadriceps

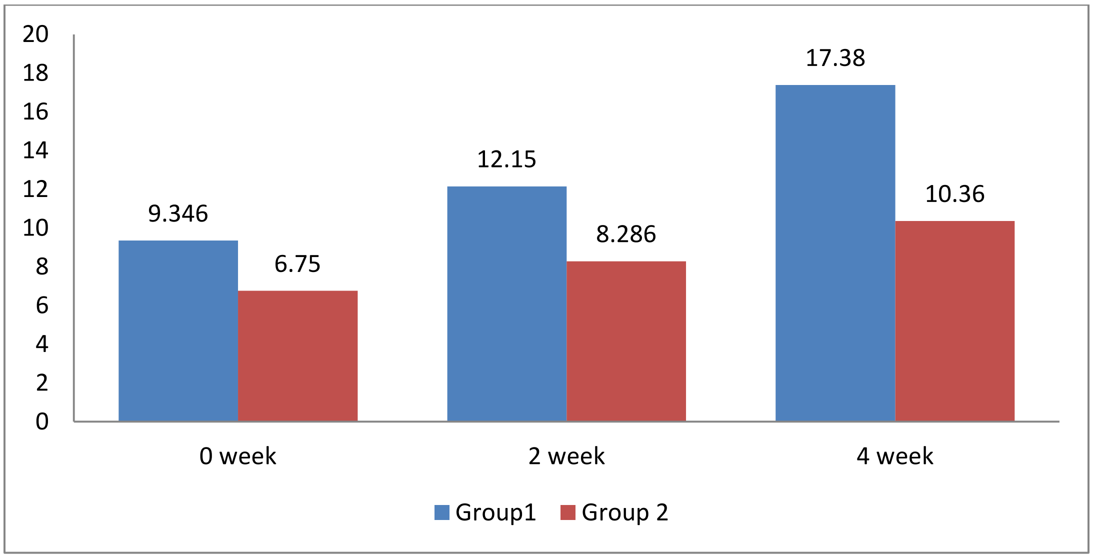


Table 10: Comparison between 0-2- 4 Weeks 1RM Hamstrings In Group 1 and Group 2

A: Descriptive Statistics

GROUP 1	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-1.615	13	0.8204	0.2275
2-4 WEEKS	-3.385	13	1.21	0.3356
0-4 WEEKS	-5	13	0.8516	0.2276

GROUP 2	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-0.7857	14	1.297	0.3466
2-4 WEEKS	-1.286	14	1.188	0.3175
0-4 WEEKS	-2.071	14	0.8516	0.2276

B: Students t test

GROUP 1 AND 2	Mean	Std. deviation	t-value	p-value
0-2 WEEKS	-0.8293	1.297	-1.967	0.060 S,p<0.05
2-4 WEEKS	-2.099	1.21	-4.547	0.000 S,p<0.05
0-4 WEEKS	-2.929	1.646	-5.871	0.000 S,p<0.05

Graph8: Comparison between Group 1 and 2 - 1RM Hamstrings

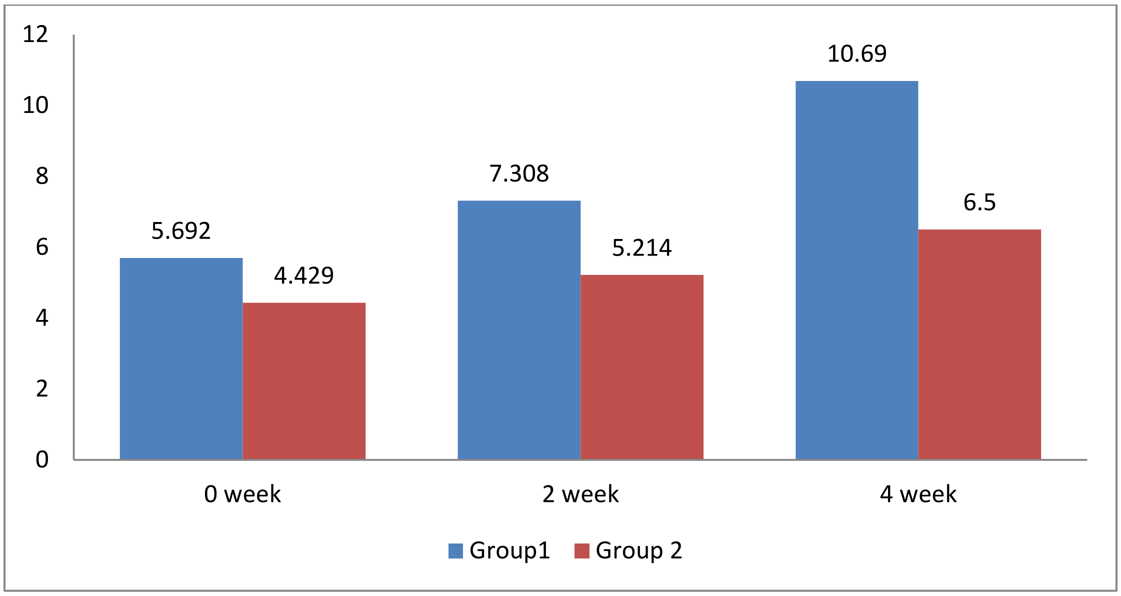


Table 11: Comparison between 0-2- 4 Weeks SVJ in Group 1 and Group 2

A: Descriptive Statistics

GROUP 1	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-6.308	13	4.768	1.322
2-4 WEEKS	-6.154	13	4.488	1.245
0-4 WEEKS	-12.46	13	8.569	2.377

GROUP 2	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-43.64	14	72.93	19.49
2-4 WEEKS	-6.786	14	2.155	0.5759
0-4 WEEKS	-50.43	14	73.4	19.62

B: Students t test

GROUP 1AND 2	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	37.33	72.93	1.839	0.078 S,p<0.05
2-4 WEEKS	0.632	4.488	0.472	0.641 S,p<0.05
0-4 WEEKS	37.97	8.569	1.851	0.076 S,p<0.05

Graph9: Comparison between Group 1 and 2 – SVJ

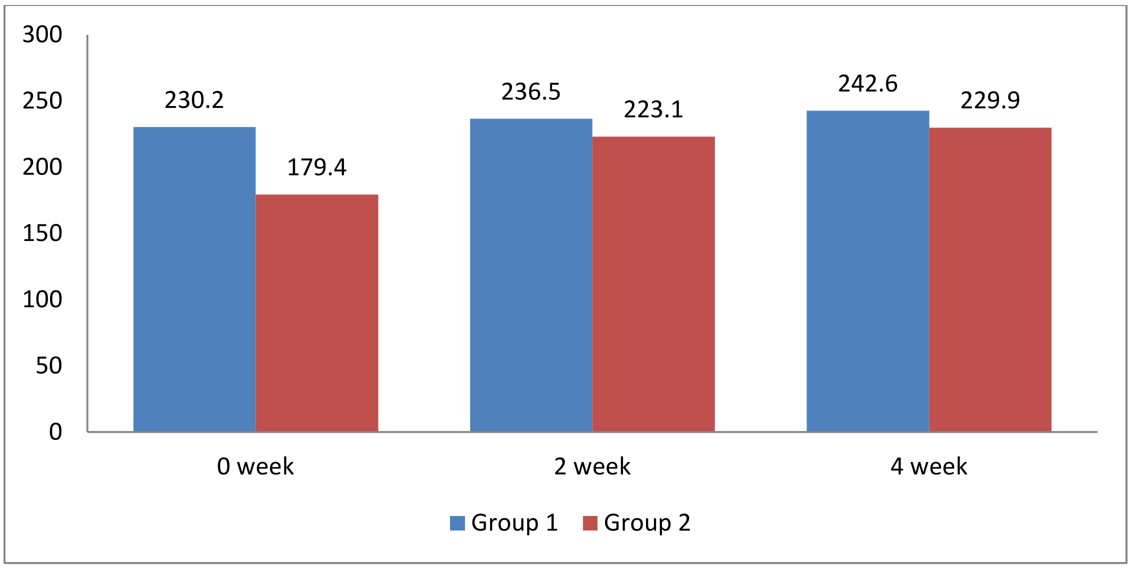


Table 12: Comparison between 0-2- 4 Weeks KD in Group 1 and Group 2

A: Descriptive Statistics

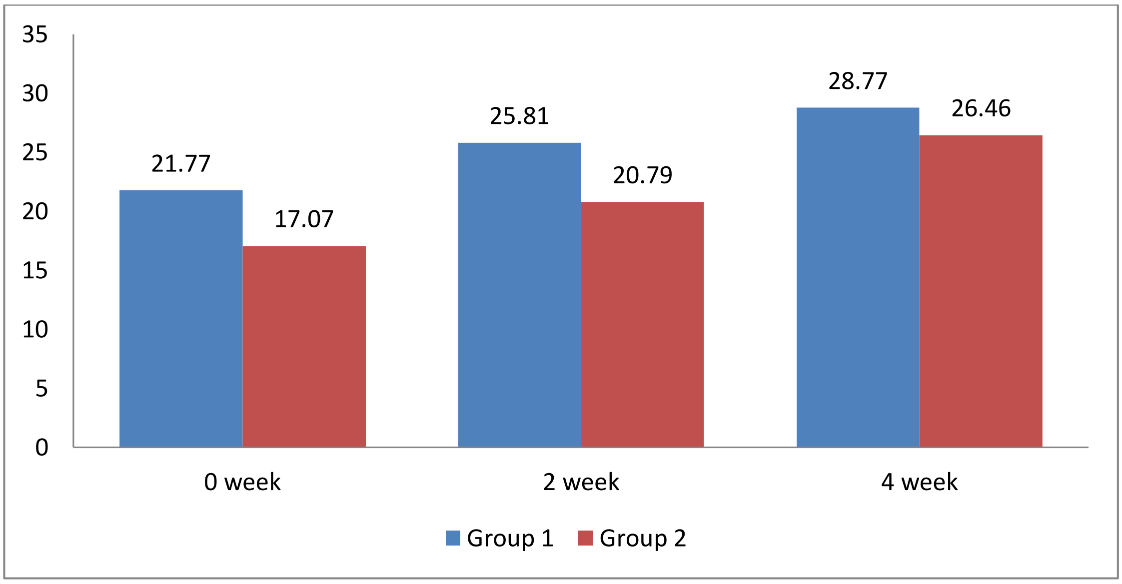
GROUP 1	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-4.038	13	2.25	0.624
2-4 WEEKS	-2.962	13	1.761	0.4884
0-4 WEEKS	-7	13	3.434	0.9524

GROUP 2	Mean	N	Std. Deviation	Std. Error Mean
0-2 WEEKS	-3.714	14	1.684	0.4501
2-4 WEEKS	-5.679	14	1.694	0.4527
0-4 WEEKS	-9.393	14	2.459	0.6572

B: Students t test

GROUP 1 AND 2	Mean	Std. Deviation	t-value	p-value
0-2 WEEKS	-0.324	2.25	-0.426	0.674 S,p<0.05
2-4 WEEKS	2.717	1.761	4.086	0.000 S,p<0.05
0-4 WEEKS	2.393	3.434	2.094	0.047 S,p<0.05

Graph 10: Comparison between Group 1 and 2 – KD



RESULTS

Table 1 show comparisons between 0-2-4 weeks **1RM quadriceps** in Group 1. Mean 1 RM at 0 week i.e. pertaining was 9.346, at 2 week were 12.15 and at 4 weeks i.e. post training were 17.38. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for 1RM quadriceps in group 1 ($t = -7.604$, $p < 0.05$ at 0-2 weeks) ($t=-8.143$, $p< 0.05$ at 2-4 weeks) and ($t=-10.288$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in strength in Group1 after training.

Table 2 show comparisons between 0-2-4 weeks **1RM hamstrings** in Group 1. Mean 1 RM at 0 week i.e. pertaining was 5.692, at 2 week was 7.308 and at 4 weeks i.e. post training was 10,69. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for 1RM hamstrings in group 1 ($t = -7.099$, $p < 0.05$ at 0-2 weeks) ($t= -10.083$, $p< 0.05$ at 2-4 weeks) and ($t= -10.954$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in strength in Group1 after training.

Table 3 show comparisons between 0-2-4 weeks **1RM quadriceps** in Group 2. Mean 1 RM at 0 week i.e. pertaining was 6.75, at 2 week were 8.285 and at 4 weeks i.e. post training were 10.36. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for 1RM quadriceps in group 2 ($t = -9.524$, $p < 0.05$ at 0-2 weeks) ($t=-7.002$, $p< 0.05$ at 2-4 weeks) and ($t=-11.603$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in strength in Group 2 after training.

Table 4 show comparisons between 0-2-4 weeks **1RM Hamstrings** in Group 2. Mean 1 RM at 0 week i.e. pertaining was 4.429, at 2 week were 5.214 and at 4 weeks i.e. post training were 6.5. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for 1RM hamstrings in group 2 ($t = -2.267$, $p < 0.05$ at 0-2 weeks) ($t=-4.408$, $p< 0.05$ at 2-4 weeks) and ($t=--9.101$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in strength in Group 2 after training.

Table 5 show comparisons between 0-2-4 weeks **SVJ** in Group 1. Mean of SVJ at 0 week i.e. pertaining was 230.2, at 2 week was 236.5 and at 4 weeks i.e. post training was 242.6. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for SVJ in group 1 ($t = -4.770$, $p < 0.05$ at 0-2 weeks) ($t=-4.944$, $p< 0.05$ at 2-4 weeks) and ($t=-5.243$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in vertical jump performance in Group 1 after training.

Table 6 show comparisons between 0-2-4 weeks **SVJ** in Group 2. Mean of SVJ at 0 week i.e. pertaining was 179.4, at 2 week was 223.1 and at 4 weeks i.e. post training was 229.9. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for SVJ in group 1 ($t = -2.239$, $p < 0.05$ at 0-2 weeks) ($t=-11.783$, $p< 0.05$ at 2-4 weeks) and ($t=-2.570$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in vertical jump performance in Group 2 after training.

Table 7 show comparisons between 0-2-4 weeks **KD** in Group 1. Mean of KD at 0 week i.e. pertaining was 21.77, at 2 week was 25.81 and at 4 weeks i.e. post training was 28.77. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for KD in group 1 ($t = -6.473$, $p < 0.05$ at 0-2 weeks) ($t=-6.602$, $p< 0.05$ at 2-4 weeks) and ($t=-7.350$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in kicking distance in Group 1 after training.

Table 8 show comparisons between 0-2-4 weeks **KD** in Group 2. Mean of KD at 0 week i.e. pertaining was 17.07, at 2 week was 20.79 and at 4 weeks i.e. post training was 26.46. By using student paired t test, the significant difference was found between 0weeks, 2weeks, 4weeks for KD in group 2 ($t = -8.254$, $p < 0.05$ at 0-2 weeks) ($t=-12.543$, $p< 0.05$ at 2-4 weeks) and ($t=-14.294$, $p<0.05$ at 0-4 weeks).This proves statistically that there is increase in kicking distance in Group 2 after training.

Table 9 shows comparison of difference of 0-2-4 weeks **1RM Quadriceps** in both groups. Mean 1RM Quadriceps in group 1 at 0-2 weeks was -2.808, at 2-4 weeks was -5.231 and at 0-4 weeks was -8.038 and mean 1RM Quadriceps in Group 2 at 0-2 weeks was -1.536, at 2-4 weeks was -2.071 and at 0-4 weeks was -3.607. By using student unpaired t test, the significant difference was found for difference of 0-2-4 weeks for 1RM quadriceps between both groups ($t =-3.239$, $p < 0.05$ at 0-2 weeks) ($t=-4.698$, $p<0.05$ at 2-4 weeks) ($t=-5.416$, $p< 0.05$ at 0-4 weeks).This proves statistically that Group 1(Basic Resistance Training) is better for improving strength of quadriceps than Group 2 (Plyometric Training).

Table 10 shows comparison of difference of 0-2-4 weeks **1RM Hamstrings** in both groups. Mean 1RM Hamstrings in group 1 at 0-2 weeks was -1.165, at 2-4 weeks was -3.385 and at 0-4 weeks was -5 and mean 1RM Hamstrings in Group 2 at 0-2 weeks was -0.0857, at 2-4 weeks was -1.286 and at 0-4 weeks was -2.071. By using student unpaired t test, the significant difference was found for difference of 0-2-4 weeks for 1RM hamstrings between both groups ($t = -1.967$, $p < 0.05$ at 0-2 weeks) ($t = -4.547$, $p < 0.05$ at 2-4 weeks) ($t = -5.871$, $p < 0.05$ at 0-4 weeks).This proves statistically that Group 1(Basic Resistance Training) is better for improving strength of hamstrings than Group 2 (Plyometric Training).

Table 11 shows comparison of difference of 0-2-4 week's **Static Vertical Jump** in both groups. Mean SVJ in group 1 at 0-2 weeks was -6.308, at 2-4 weeks was -6.154 and at 0-4 weeks was -12.46 and mean SVJ in Group 2 at 0-2 weeks was -43.64, at 2-4 weeks was -6.786 and at 0-4 weeks was -50.43. By using student unpaired t test, the significant difference was found for difference of 0-2-4 weeks for SVJ between both groups ($t = 1.839$, $p < 0.05$ at 0-2 weeks) ($t = 0.472$, $p < 0.05$ at 2-4 weeks) ($t = 1.851$, $p < 0.05$ at 0-4 weeks).This proves statistically that Group 1(Basic Resistance Training) and Group 2 (Plyometric Training) both are equally effective in improving the vertical jump performance.

Table 12 shows comparison of difference of 0-2-4 week's **Kicking Distance** in both groups. Mean KD in group 1 at 0-2 weeks was -4.038, at 2-4 weeks was -2.962 and at 0-4 weeks was -7 and mean KD in Group 2 at 0-2 weeks was -3.714, at 2-4 weeks was -5.679 and at 0-4 weeks was -9.393. By using student unpaired t test, the significant difference was found for difference of 0-2-4 weeks for KD between both groups ($t = -0.426$, $p < 0.05$ at 0-2 weeks) ($t = 4.086$, $p < 0.05$ at 2-4 weeks) ($t = 2.094$, $p < 0.05$ at 0-4 weeks).This proves statistically that Group 1(Basic Resistance Training) is better for improving the kicking distance than Group 2 (Plyometric Training)

DISCUSSION

The hamstring strain is a condition well recognized by medical personnel, coaches, and athletes. Such injuries are a major cause of time lost from sport. Hamstring strains are among the most common injuries in sport and are most often observed in sports that involve sprinting and jumping. The initial Football Association Audit of Injuries study found that 12% of all injuries reported over two seasons were hamstring strains, this being the most prevalent injury. Players were 2.5 times more likely to sustain a hamstring strain than a quadriceps strain during a game.[19]

Many predisposing factors for hamstring strain have been suggested in the literature, including insufficient warm up, poor flexibility, muscle imbalances, muscle weakness, neural tension, fatigue, dys-synergic contraction of muscle groups, and previous injury. The evidence to substantiate these speculations is minimal and conflicting. [19]

Hamstring strains are well known for their high rate of recurrence. It has been suggested that a premature return to play or an inappropriate rehabilitation programme may be responsible for reinjures.[19] Garrett stated that although muscle strains are frequently seen, our understanding of the pathophysiology, treatment, and recovery of these injuries is limited. Muscle strain injuries occur when the muscle is either stretched passively or activated during stretch.[33]

In activities like sprinting and kicking, the greatest lengths (stretches or strains) of the hamstring and rectus femoris muscles occur during swing phases. However, maximum external joint moments (forces which oppose muscle action) and consequent stress on muscles occurs during ground phases.[33]

Recent hamstring strain has been found to be a risk for quadriceps strain. It is possible that during recovery from a hamstring strain, alterations are made to gait, which include reducing the stride length, protecting the weakened hamstring muscle from re-strain but increasing the chance of a secondary quadriceps strain.[33] Australian football study which observed an average of six hamstring strains per club per season, with hamstring strains representing 15% of all injuries.[19]

The high incidence of injury in this muscle group may be partly because the group functions over two joints and is therefore subject to stretch at more than one point. Also, the greater proportion of fast twitch fibers in the hamstring muscles compared with other thigh and leg muscles means that they are capable of high force production. Common muscle imbalance patterns may invoke the use of the hamstrings as a slow twitch muscle, which may predispose the muscle to injury when challenged to perform high velocity fast twitch actions. It may therefore be worth while addressing any muscle imbalances when assessing and treating these injuries. [19]

The weight training or resistance training is one of the most popular forms of exercise for enhancing an individual's fitness as well as for conditioning athletes. Coaches and athletes are well aware that the system of resistance training they select will influence strength and power. [21]

Several studies have shown that weight training can improve power along with strength. Many studies show that there is 7% improvement in vertical jump following 24 weeks training. Both heavy and light resistance training can be used in training of muscular power. Maximum strength can be developed through careful designed resistance training program. [22]

Harris reported improvement in vertical jump with traditional weight training but less improvement as compared to when combination of traditional weight training and explosive training was given. However, Moore et al, did not find any significant difference when plyometric exercises were combined to traditional weight lifting in improvement of vertical jump.[26]

Much research has been focused on the development of vertical jump performance. Although various training methods, including heavy-resistance training, explosive type resistance training, electro stimulation training and vibration training, have been effectively used for the enhancement of vertical jump performance, most coaches and researchers seem to agree that plyometric training (PT) is a method of choice when aiming to improve vertical jump ability and leg muscle power. [3]

Studies carried out by authors such as Blattner and Noble (1979) and Bosco (1982) have shown that Plyometric Training has a significant effect in increasing hip and thigh power that is measured by the vertical jump. Bosco believes that these results from enhancing motor unit recruitment and improving the muscles ability to store kinetic energy within the elastic components of the muscle (Bosco, et. al.1982).This may enhance hip and thigh power by increasing the explosive capabilities of the athlete thus enhancing the vertical jump performance. [16]

Researchers have shown that plyometric training, when used with a periodized strength-training program, can contribute to improvements in vertical jump performance, acceleration, leg strength, muscular power, increased joint awareness, and overall proprioception (Adams, et al., 1992).Plyometric drills usually involve stopping, and changing directions in an explosive manner. These movements are components that can assist in developing agility (Craig 2004; Miller et al 2001; Parsons et al 1998; Yap et al 2000).

1 RM as outcome measure is used in various researches for assessing strength of individual. The one-repetition maximum (1RM) test is considered the gold standard for assessing muscle strength in non-laboratory situations Most previous 1RM reliability studies have been conducted with experienced young participants.[27]

Itamar Levingera conducted a study to examine the reliability of the 1RM strength tests on untrained middle-aged individuals and concluded that 1RM is a reliable method of evaluating the maximal strength in untrained middle-aged individuals. It appears that 1RM-testing protocols that include one familiarization session and one testing session are sufficient for assessing maximal strength in this population.($r > 0.9$).

Lex B. Verdijk concluded One-repetition maximum strength test represents a valid means to assess leg strength. Radmila Kostić in his study concluded that the exercise program with a 75% of 1RM had a better effect on the development of muscle strength in the middle aged women.

Vertical jump test is one of the power assessment tests. For most athletes maximum vertical jump height is very important variable that applies directly to the performance of many sports. Vertical jump height is frequently used by coaches, health care professionals, and strength and conditioning professionals to objectively measure function. (Validity of two systems measuring the vertical height). (Reliability: ICC- 0.93 & Validity: ICC- 0.8 Chu, 1996).

Kicking distance is a functional outcome measure used to evaluate a player's athletic performance. In this study there were two groups. Group 1 was given Basic Resistance Training and Group 2 was given Plyometric Training for 4 weeks, 4 days/week. Strength, power and kicking distance was assessed before training, 2 weeks after training and 4 weeks after training.

Table 1 and 2 shows significant difference in 1 RM in quadriceps and hamstrings between 0-2-4 weeks of Group1 (Basic Resistance Training).This shows improvement in strength in quadriceps and hamstrings following resistance training. Quadriceps has shown greater improvement in strength than hamstrings.

Table 3 and 4 shows significant difference in 1 RM in quadriceps and hamstrings between 0-2-4 weeks of Group2 (Plyometric Training).This shows improvement in strength in quadriceps and hamstrings following plyometric training. Quadriceps has shown greater improvement in strength than hamstrings.

Improvement in individual's muscle strength and power after weight training is mainly because of two factors:

- Neural – motor component
- Contractile component

NEURAL – MOTOR COMPONENT

Following are the neural adaptations with weight training

- Increased integrated electromyography
- Increased rate of motor unit activation
- Improved motor unit synchronization
- Lowering of neural inhibitory reflex
- Inhibition of Golgi tendon organ

CONTRACTILE COMPONENT

- Muscle size

Various neural adaptations occur after weight training are stated above. This causes increase in strength. Neural facilitation increases which largely accounts for rapid and significant increase in early weeks which often occurs without increase in muscle size and cross – sectional area. The amount of training that occurs in muscle fiber is determined by the extent to which it is recruited.[25]

There is also increase in electric activity of muscle in strength training. This is given by increased integrated electromyography activity. There is significant increase in strength in novice individual; this reflects enhanced ability to recruit motor units. Studies show neural adaptation play greater role in increasing strength during early phase of strength training in women. Lifting heavy weights for few repetitions, causes maximal stimulation of muscle, leading contraction of many fibers at same time.[25]

There is also muscle tissue adaptation in which muscle size increases, cross –sectional area are increase and there is high relationship between cross- sectional area
and strength.[25]

Weight training causes neural adaptations leading to improvement in muscle power. There is increase in motor unit firing rate. Firing rate is controlled by central nervous system. Motor unit firing rate affects rate of force development. Force rate is important in improving power.[25]

Neural adaptation increases strength and improve co–ordination. This is helpful in powerful movements because there is increased contractile capacity and synchronized release of elastic energy within muscle. These neural adaptations include reflex motor unit facilitations of contraction, improved motor unit synchronization and inhibition of Golgi tendon organ.[25]

Synchronization of motor unit firing rate also cause greater power and increase the time during which high muscle tension can be maintained. Neural disinhibition is reduced by training which affects Golgi tendon organ role in preventing full contractions. Therefore, allows more forceful contraction.[25]

Table 5 shows significant difference in power in terms of Static Vertical Jump between 0-2-4 weeks of Group1. This shows improvement in vertical jump performance following resistance raining. Table 6 shows significant difference in power in terms of Static Vertical Jump between 0-2-4 weeks of Group2. This shows improvement in vertical jump performance following plyometric training.

Several studies used plyometric training and have shown that it improves power output and increases explosiveness (Adams et al1992, Ioannis et. al2000) by training the muscles to do more work in a shorter amount of time (Holcomba 1996). This is accomplished by optimizing the stretch-shortening cycle, which occurs when the active muscle switches from rapid eccentric muscle action (deceleration) to rapid concentric muscle action (acceleration) (Wagner & Kocak 1997, Potteiger et. al 1999). The rapid eccentric movement creates a stretch reflex that produces a more forceful concentric muscle action (Wagner & Kocak 1997, Cachnce1995) than could otherwise be generated from a resting position (Potteiger, et. al.1999). The faster the muscle is stretched, the greater the force produced, and the more powerful the muscle movement (Clutch et. al1983, Wagner & Kocak 1997). Plyometric exercises that exploit the stretch-shortening cycle have been shown to enhance the performance of the concentric phase of movement (Gehri et. al1998) and increase power output (Adams et al 1992).[16]

Plyometric exercises evoke the elastic properties of the muscle fibers and connective tissue in a way that allows the muscle to store energy during the deceleration phase and release that energy during the acceleration period.[16]

There is a close working relationship between neuromuscular efficiency (e.g. multiple fiber recruitment and facilitating the stretching reflex) and dynamic strength performance. The role of plyometrics is to facilitate the neuromuscular system into making a more rapid transition from eccentric to concentric contractions, whereby maximal ballistic force is generated. Thus it is believed that plyometric training is the link between speed and strength.[16]

Table 7 shows significant difference in power in terms of Kicking Distance between 0-2-4 weeks of Group1. This shows improvement in kicking distance indicating the player's athletic performance following resistance training.

Table 8 shows significant difference in power in terms of Kicking Distance between 0-2-4 weeks of Group1. This shows improvement in kicking distance indicating the player's athletic performance following resistance training.

Kicking plays a very important role in enhancing the athletic performance. The balance between quadriceps and hamstring muscles should be maintained to reduce the muscle strains and knee injuries and enhance the functional performance of an athlete.[29/32] One of the goals in a resistance program is balance. Proper resistance training enhances an effective quadriceps and hamstring strengthening and thus helps to maintain the balance between quadriceps and hamstring muscle strength. This allows the player to maintain a good static and dynamic balance which is required for jumping, kicking performance and an overall athletic performance.[32]

In this study, table 9 shows significant difference for comparison between difference of 0-2- 4 weeks for 1RM Quadriceps in group 1 and 2. This shows that resistance training is more effective in improving the strength of quadriceps muscle than plyometric training.

In this study, table 10 shows significant difference for comparison between difference of 0-2- 4 weeks for 1RM hamstrings in group 1 and 2. This shows that resistance training is more effective in improving the strength of hamstrings muscle than plyometric training.

In this study, table 11 shows significant difference for comparison between difference of 0-2- 4 weeks for Static Vertical Jump in group 1 and 2. This shows that resistance training plyometric training are equally effective in improving the vertical jump performance.

In this study, table 12 shows significant difference for comparison between difference of 0-2- 4 weeks for Kicking Distance in group 1 and 2. This shows that resistance training is more effective in improving the kicking distance indicative of an improvement in the athletic performance than plyometric training.

A 4 week program of resistance training is effective in improving the strength of quadriceps and hamstrings muscle thus enhancing the athletic performance and also reduces the incidences of strains and injuries around the knee in football players. Quadriceps muscle shows more improvement in strength than hamstring muscle.[4] Also resistance training enhances the kicking performance by maintaining a proper balance between quadriceps and hamstring muscle. This allows the player to maintain a good static and dynamic balance which is essential for a good kicking performance.[32] A plyometric training of 4 weeks helps to improves power output and increases explosiveness (Adams et al1992, Ioannis et. Al 2000) by training the muscles to do more work in a shorter amount of time (Holcomba 1996).

The results of this study suggest that the neuromuscular characteristics of the lower extremity can be improved with a basic exercise program alone. Additionally, a plyometric program may further be utilized to improve muscular activation patterns.[4]

CONCLUSION

This study concludes that Basic Resistance Training is effective in improving the strength of quadriceps and hamstrings muscles in football players. Both the Basic Resistance Training and Plyometric Training are equally effective in improving the power i.e. vertical jump performance in football players. Basic Resistance Training is effective in improving the kicking distance in the football players compared to Plyometric Training.

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CONSENT FORM

Title: - Effect of Basic Resistance training versus Plyometric training in high school football players.

Participant: - I confirm that _______________ (investigator) has explained me the purpose of the research, the study procedure and the possible risks and benefits that I may experience. I have read and understood this consent to participate as a subject in this research project.

Name: -

Date: -

Signature: –

INVESTIGATOR: –

I have explained to ______________________________________ the purpose of the research, the procedure required and the possible risk and benefits to the best of my ability. I have made every effort to make the participant understand and cleared all questions put forward by him.

Name of the investigator

Date: -

Signature

DOUBLE LEG FORWARD HOP

DOUBLE LEG JUMP FROM THE BOX

DOUBLE LEG BACKWARD HOP

DOUBLE LEG LATRERAL HOP

DOUBLE LEG JUMP- LUNGE- JUMP

SHUTLLE RUN

45 DEGREE CUT

90 DEGREE CUT

HIGH KNEES